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OCEAN DISPOSAL ACTIVITIES SUMMARY 1997 PACIFIC AND YUKON REGION

ENVIRONMENT CANADA
ENVIRONMENTAL PROTECTION BRANCH

PACIFIC AND YUKON REGION

Regional Program Report: 1999-02

Canada

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OCEAN DISPOSAL ACTIVITIES SUMMARY

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Report No. 1999-02

Regional Program Report by:

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ABSTRACT

Environment Canada's administration of ocean disposal activities undertaken in the Pacific and Yukon Region from 01 January 1997 to 31 December 1997 is summarized in this report. Ocean disposal sites in this Region are used primarily for the disposal of dredged and excavated spoils. This report includes information on twelve disposal sites that were active in 1997 and five disposal site monitoring programs.

This report is a continuation of a series of reports documenting ocean disposal activities from 1975 to 1996 and includes Ward and Sullivan (1980), Sullivan (1987), Kim and Sullivan (1993), Kim et al. (1997), Sullivan et al. (1997), Schnider and Sullivan (1997a), and Schnider and Sullivan (1997b). These reports and other information are available on our website at http://www.pyr.ec.gc.ca/ep/ocean-disposal.

RÉSUMÉ

Ce rapport résume les activités d'Environnement Canada en matière d'application de la partie VI de la Loi canadienne sur la protection de l'environnement (LCPA) (dépôts de déchets en mer). Plus spécifiquement, il contient de l'information sur les activités de 12 sites de dépôt dans la région du Pacifique et du Yukon au cours de l'année 1997 et les données fournies concernent les contrôles effectués dans 5 de ces sites. Les sites de cette région servent principalement au dépôt des materiaux de dragage et d'excavation.

Ce rapport s'incrit dans une série de rapports préparés pour la période comprise entre 1975 et 1996: Ward et Sullivan (1980), Sullivan (1987), Kim et Sullivan (1993), Kim et al. (1997), Sullivan et al. (1997), Schnider et Sullivan (1997a) et Schnider et Sullivan (1997b). Ces rapports sont disponibles sur notre addresse internet au http://www.pyr.ec.gc.ca/ep/ocean-disposal.

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1.0 INTRODUCTION

Environment Canada has administered the requirements for ocean disposal of wastes since 1975 under authority of the *Ocean Dumping Control Act* (ODCA). In 1988 this legislation was replaced by the *Canadian Environmental Protection Act* (CEPA), Part VI. Material destined for ocean disposal requires a permit issued by Environment Canada. To ensure compliance with the conditions of the permit, inspections are routinely conducted by Environment Canada, Enforcement and Emergencies Division.

Within Canada, ocean disposal sites are divided into four geographical regions: Atlantic, Prairie and Northern, Quebec, and Pacific and Yukon. This report describes all ocean disposal activities conducted in 1997 in the Pacific and Yukon Region (Figure 1). There are thirty-five designated sites in Southern British Columbia. In 1997, twelve of these disposal sites were used and five were monitored (Table 1).

2.0 ADMINISTRATION

2.1 APPLICATION AND REVIEW PROCESS

Under the authority of CEPA Part VI, material destined for ocean disposal or loaded for the purpose of ocean disposal requires an Ocean Disposal Permit. Permit applications are reviewed by Environment Canada (EC) with advice from the Regional Ocean Disposal Advisory Committee (RODAC). This committee has representation from Environment Canada, the Department of Fisheries and Oceans (DFO) and British Columbia Ministry of Environment, Lands and Parks. Information on the application process can be obtained from Environment Canada, 224 West Esplanade, North Vancouver, B.C., V7M 3H7 and are online at http://www.pyr.ec.gc.ca/ep/ocean-disposal. Figure 2 shows the complete permitting process.

The public is advised of the application via a Notice of Intent that the applicant publishes in a newspaper local to the area of the proposed activity. The public can address their comments to Environment Canada throughout the application review process. All environmental screenings can be viewed by the public at the *Canadian Environmental Assessment Act* (CEAA) Public Registry at 224 West Esplanade, North Vancouver, B.C., V7M 3H7, or on the website, http://ecncr-notes.ncr.ec.gc.ca/glea/index.html.

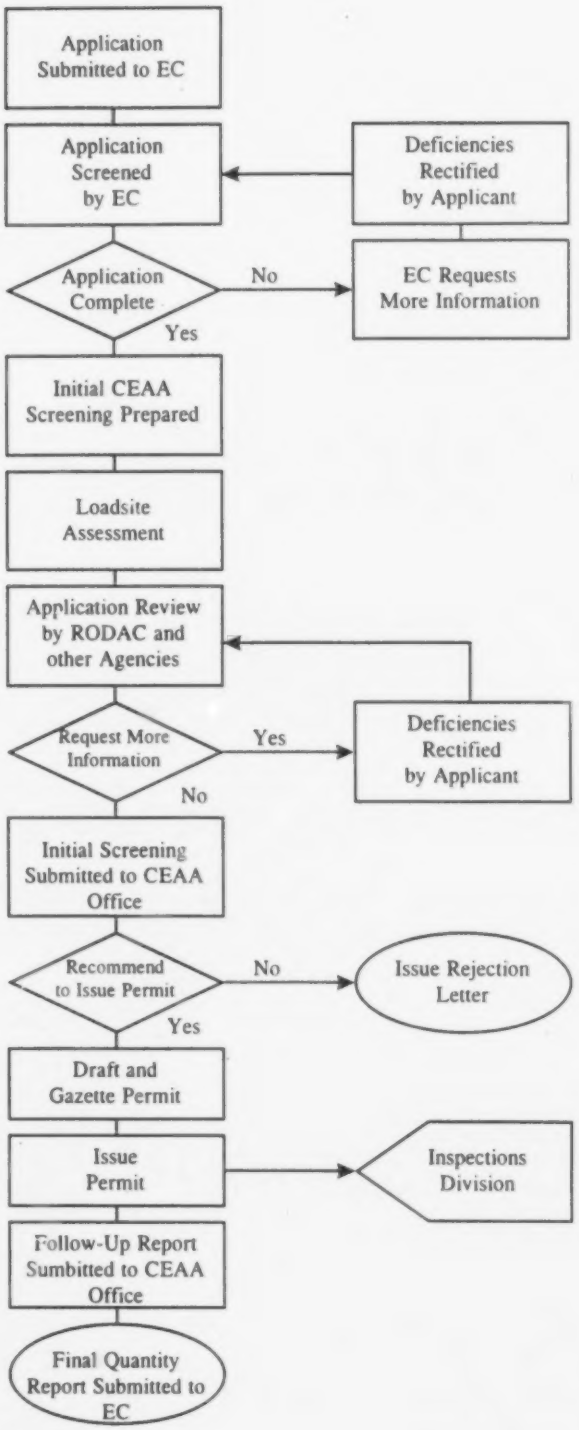
Based on the initial review of an application, inspection and sampling by EC personnel may be required to assess the proposed loadsite. Following the application review process, only material which has been rigorously tested and found to meet the criteria outlined in the Interim Contaminant Testing Guidelines for Ocean Disposal (ICTG), Pacific and Yukon Region (Appendix I), is approved for ocean disposal. All ocean disposal permits and amendments must be published in the Canada Gazette before they are issued. Permits are valid for a one year period.

Figure 1. Location map.

Table 1. Active ocean disposal sites.

Number	Disposal Site	Depth (m)	Co-ordinates	Volume Disposed in 1997
* 1	Point Grey	210	49°15.40'N; 123°22.10'W	618 621 m^3
9	Sand Heads	70	49°06.00'N; 123°19.50'W	889 457 m^3
32	Porlier Pass	200	49°00.20'N; 123°29.80'W	13 400 m^3
* 40	Five Finger Island	280	49°15.20'N; 123°54.60'W	10 300 m^3
* 44	French Creek	200	49°22.50'N; 124°19.00'W	0 m^3
* 48	Comox (Cape Lazo)	190	49°41.70'N; 124°44.50'W	4 000 m^3
49	Malaspina Strait	320	49°45.00'N; 124°27.00'W	20 368 m^3
64	Thornbrough Channel	220	49°31.00'N; 123°28.30'W	4 000 m^3
65	Watts Point	230	49°38.50'N; 123°14.00'W	10 100 m^3
* 114	Thormanby Island	384	49°27.50'N; 124°04.50'W	0 m^3
119	Johnstone Strait - Hickey Point	270	50°27.80'N; 126°04.80'W	6 000 m^3
120	Johnstone Strait - Hanson Island	350	50°33.50'N; 126°48.00'W	15 600 m^3
154	PWC 5	10	49°09.40'N; 122°59.70'W	12 000 m^3
161	Snake Island	32	49°13.30'N; 123°53.10'W	2 400 tonnes
			Total:	1 603 846 m^3 2 400 tonnes

* Monitoring studies were conducted at these disposal sites in 1997.



RODAC Agencies

DOE -	Pollution Prevention and Assessment Division
DFO -	Science and Research
DFO -	Habitat Management
MELP -	Pollution Prevention and Remediation Branch

Legend

EC -	Environment Canada
RODAC -	Regional Ocean Disposal Advisory Committee
MELP -	Ministry of Environment, Lands and Parks
DFO -	Department of Fisheries and Oceans
CEAA -	Canadian Environmental Assessment Act

Figure 2. Ocean disposal permitting process.

Maintenance dredging activities involving less than 4 000 cubic metres of dredged material, or excavation projects involving clean native till may be undertaken under the terms and conditions of a general ocean disposal permit. New dredging projects or maintenance activities involving volumes in excess of 4 000 cubic metres require a site-specific permit.

2.2 OCEAN DISPOSAL RESTRICTIONS

Under Schedule III, Parts I and II, certain substances are prohibited or restricted from ocean disposal. In addition, the ICTG further outline the criteria for polycyclic aromatic hydrocarbons, polychlorinated biphenyls, chlorophenols and dioxins/furans.

The substances listed in Part I are generally prohibited when present at dry weight concentrations in excess of those specified below unless, in the opinion of the Minister, the substance will be rapidly rendered harmless by physical, chemical or biological processes of the sea at the specified disposal site:

a) Organohalogen compounds

• Chlorophenols (PCP and TCP)	1.0 µg/g
• Polychlorinated biphenyls (PCB)	0.1 µg/g
• Polycyclic aromatic hydrocarbons (PAH)	2.5 µg/g
• Dioxin (2,3,7,8 TCDD)	Quantifiable

b) mercury and mercury compounds in a solid phase of a waste (0.75 µg/g), and in the liquid phase of a waste (1.5 µg/g);

c) cadmium and cadmium compounds in the solid phase of a waste (0.6 µg/g), and in the liquid phase of waste (3.0 µg/g);

d) persistent plastics and other persistent synthetic materials (four percent by volume), in a suitably comminuted form;

e) crude oil and its wastes, refined petroleum products, petroleum distillate residues and any mixtures containing any of those substances (any quantity that yields more than 10.0 µg/g of n-hexane soluble substances);

f) radioactive wastes and other radioactive matter;

g) substances in whatever form produced for biological and chemical warfare; and

h) industrial waste, namely, material that comes from manufacturing or processing operations and is waste, other than:

- dredged material;

- fish waste or other organic matter that comes form industrial fish processing operations;
- ships, platforms or other anthropogenic structures at sea, provided that material capable of creating floating debris or otherwise polluting the marine environment has been removed;
- uncontaminated inert geological material; and
- uncontaminated organic matter of natural origin.

Under Part II, the following substances are restricted when present in significant amounts. In dredged material, lead is considered to be present in significant amounts when contained in wastes at concentrations of 0.05 percent or more by weight (500 µg/g) and arsenic, copper, zinc, beryllium, chromium, nickel and vanadium when present at concentrations of 0.1 percent (1000 µg/g). Pacific RODAC considers these levels as general guidelines only and may impose more stringent limits.

a) arsenic and its compounds;
b) lead and its compounds;
c) copper and its compounds;
d) zinc and its compounds;
e) organosilicon and its compounds;
f) cyanides;
g) fluorides;
h) pesticides and their by-products not included in the List of Prohibited Substances in Part I;
i) beryllium and its compounds;
j) chromium and its compounds;
k) nickel and its compounds;
l) vanadium and its compounds;
m) containers and scrap metal;
n) substances that by reason of their bulk would interfere with fishing; and
o) substances that, though of a non-toxic nature, may become harmful due to the quantities in which they are dumped, or that are liable to seriously reduce amenities.

In order to protect fisheries resources, spawning areas, and juvenile and adult migratory areas, the Department of Fisheries and Oceans (DFO) requires that dredging and/or ocean disposal activities be conducted within time frames specified by district Habitat Management Units. Proponents are directed to contact the appropriate DFO units prior to commencing any projects for timing restrictions relevant to the area of proposed activities. For example, Fraser River dredging guidelines for operations within navigation channels specify periods when clamshell or suction dredging is allowed. Dredging outside navigation channels is reviewed on a site-specific basis.

2.3 COMPLIANCE AND ENFORCEMENT

Environment Canada, Pollution Prevention and Assessment Division, conducts pre-load inspections to verify sampling program design and collect samples as required. Enforcement of the terms and conditions of permits under CEPA, Part VI, is the responsibility of the Inspections Section, Enforcement and Emergencies Division. CEPA inspectors routinely conduct compliance and surveillance inspections of dredging/loading and disposal operations. Vessel Traffic Management Centres monitor disposal sites to ensure disposal activities occur at the authorized locations. Any contravention of permit conditions are dealt with under authority of CEPA, Part VI or Section 36 (3) of the *Fisheries Act*.

3.0 DISPOSAL SITE MONITORING

Disposal site monitoring procedures are outlined in the Interim Monitoring Guidelines for Ocean Disposal (1993). Physical monitoring is the first stage of the monitoring approach. Of key importance is the collection of geological information to determine the area of deposition, delineation of the disposal site boundaries, the accumulation of material within the boundaries and evidence of sediment transport off the disposal site.

Chemical assessment of a disposal site is aimed at measuring chemical concentrations of sediment from within the disposal site boundary and from one or more nearby reference stations, removed from ocean disposal activity. Comparing these results, Environment Canada attempts to determine whether disposal activities are altering the chemical make-up of sediment within the disposal site.

Biological testing is focused primarily on laboratory toxicity testing and benthic community studies. Biological testing protocols were completed in 1992 and continue to be evaluated for use in disposal site assessment. In addition, Environment Canada has published "Guidance Document on the Collection and Preparation of Sediment for Physiochemical Characterization and Biological Testing" (1994).

All available information from physical, chemical and biological monitoring is considered in the overall assessment of a disposal site.

4.0 OCEAN DISPOSAL ACTIVITIES

4.1 NUMBER OF PERMITS

In 1997, nineteen ocean disposal permit applications were received and twenty-one permits were issued (Table 2): six for excavated material, fourteen for dredged material and one for a decommissioned vessel.

Under general permits for dredged and excavated materials, 133 projects were assessed and approved in 1997. Thirty eight approvals were issued for excavation projects in the lower mainland and 95 approvals were issued for maintenance projects involving less than 4 000 cubic metres of dredged material.

Table 2. Number of permits issued in the Pacific and Yukon Region - 1987 to 1997.

Permit Type	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Dredge	33	41	28	25	23	20	21	18	20	15	14
Excavation	2	5	5	4	4	5	3	2	4	6	6
Vessel	0	0	1	0	2	2	0	0	1	2	1
Others	2	2	2	2	1	0	1	0	0	0	0
Total	37	48	36	31	30	27	25	20	25	23	21

4.2 VOLUME OF MATERIAL OCEAN DISPOSED

In 1997, approximately 1.6 million cubic metres of material was disposed of at various disposal sites in the Pacific and Yukon Region. The Point Grey and Sand Heads disposal sites received approximately 95% of all materials.

Dredged material accounted for approximately three-quarters of the material sent to disposal sites while excavation projects in the lower mainland accounted for the other quarter.

In 1997, approximately 876 000 cubic metres of sand from the Fraser River Channel maintenance dredging was ocean disposed of at the Sand Heads disposal site. In future, sand recovery and sales from construction projects may greatly reduce the need for ocean disposal of sediment resulting from channel maintenance.

4.3 MONITORING

Routine monitoring of ocean disposal sites is carried out by Environment Canada to assess physical, chemical and biological effects of disposal operations. At each designated ocean disposal site, a grid of sediment sampling stations has been established to allow repetitive surveys.

In October 1997, five designated disposal sites were monitored: Point Grey, Five Finger Island, French Creek, Comox and Thormanby Island. All sediments collected were analysed for trace metals, and particle size distribution. Additionally, sediment samples collected at Five Finger Island sampling stations and composite samples from French Creek, Comox and Thormanby Island disposal sites were analyzed for concentrations of total polycyclic aromatic hydrocarbon (TPAH) and total organic carbon (TOC).

Sediment toxicity tests are conducted to determine and monitor effects of ocean disposed sediments on the receiving environment. Sediment samples from Five Finger Island disposal site and composite samples from French Creek, Comox and Thormanby Island disposal sites were tested for toxicity using the solid phase and the liquid phase Microtox® test.

Sidescan sonar mosaics of the Point Grey disposal site and surrounding area were generated from surveys conducted in September and October 1996 and October 1997 in cooperation with the Geological Survey of Canada, Pacific Geoscience Centre. Results of this survey are included in Section 5.1.

In June 1997, video images of Point Grey disposal site were recorded using a remotely operated submersible, known as the Remotely Operated Platform for Ocean Science (ROPOS II) owned by DFO and operated by the Canadian Scientific Submersible Facility. Predetermined transect lines were followed across the disposal site to examine bottom conditions and evidence of ocean disposal activities. Discussion of the physical monitoring conducted at Point Grey is presented in Section 5.1.

5.0 ACTIVE DISPOSAL SITE INFORMATION

The total quantity of materials found under disposal headings in the following sections is the total quantity disposed of under permit/approval since 1976. Information on specific permits and approvals in 1997 at each disposal site can be found in the disposal site summaries located in Appendix II.

Where trace metal concentrations are reported in the following sections, results are expressed as dry weight total metals.

5.1 POINT GREY

Disposal Site:	Point Grey
Number:	1
Co-ordinates:	49°15.40'N; 123°22.10'W
Depth:	210 metres
Total Quantity Disposed Since 1976:	8 571 757 cubic metres + 390 tonnes

Comments

DFO requests that Vancouver Harbour and the Fraser River Dredging Guidelines be applied to any dredging project, subject to approval by the appropriate Habitat Management Unit.

Loadsite Information

Over 206 000 cubic meters of dredged material were sent to the Point Grey disposal site in 1997. This material resulted from maintenance dredging operations at various locations in Vancouver Harbour and the Fraser River. In addition, over 412 000 cubic meters of excavated native till from the Greater Vancouver area were taken to the disposal site.

Monitoring Information

In September and October 1996, a comprehensive sidescan sonar survey was conducted in conjunction with the Pacific Geoscience Centre. A mosaic of the Point Grey disposal site was produced for each sidescan sonar survey (Figures 3 and 4). Evidence of disposal activity can be seen on these mosaics. Subtraction of one image from another yields a "difference" mosaic (Figure 5). Between these surveys, approximately 85 000 cubic metres of dredged and excavated material was disposed of at the Point Grey site. Dredged woodwaste and river sediment is normally removed from the barges by front-end loaders leaving clearly defined "strings of pearls" on the mosaics. Excavation material is normally transported to the site in split-hull barges and the disposal, which occurs in a matter of minutes, leaves large white "splotches" on the sidescan mosaic.

In June 1997, ROPOS II was deployed at the Point Grey disposal site. As part of a physical monitoring program, the remotely operated vehicle (ROV) is used to observe the benthic condition of the disposal site and surrounding area. In addition, information on the area of deposition of materials, and physical characteristics of sediment in and around the disposal site boundary can be gathered from ROPOS video. Predetermined track lines were plotted over the disposal site and continuous video images were recorded. Computer-captured still images (transferred to slide and CD ROM) were also collected. A selection of these images is presented in Appendix III.

In October 1997, surface sediment samples were collected from 33 stations on the disposal site and the surrounding area (Figure 6). The samples were analyzed for trace metal concentrations and particle size distribution. Results are presented in Table 3. No chemical concentrations exceeded the screening limits outlined in the ICTG.

Also in October 1997, the second phase of a comprehensive sidescan sonar survey was completed. The survey included the disposal site and surrounding area, covering approximately 36 square nautical miles. The results are being assembled into a mosaic image by the Pacific Geoscience Centre in Sidney, British Columbia. Initial observations indicate that material sent for disposal is being deposited within the dispoal site boundaries.

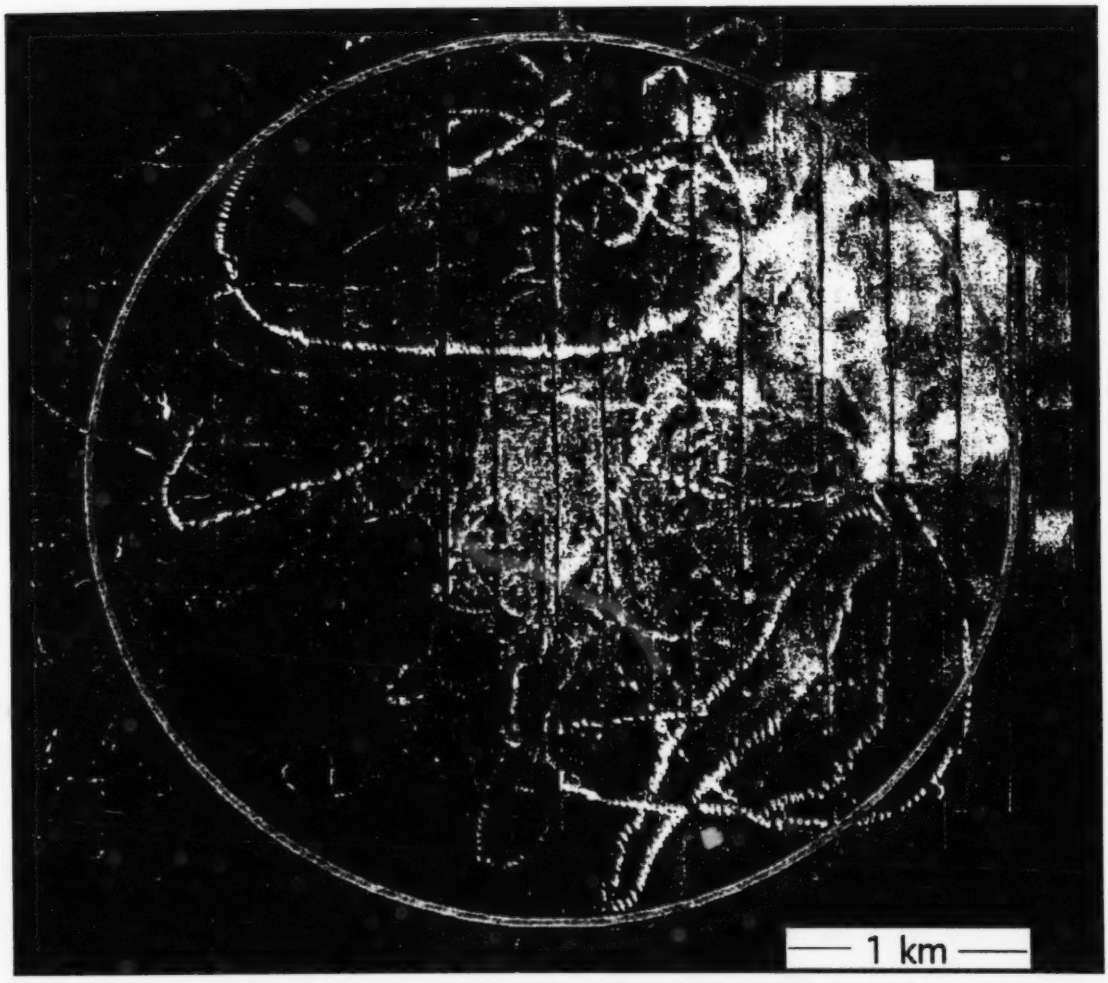


Figure 3. Sidescan sonar mosaic of Point Grey disposal site - September 1996. The image is centered at 49°15.4'N; 123°22.1'W, north at the top of the page. The area within the circle represents the designated disposal area.

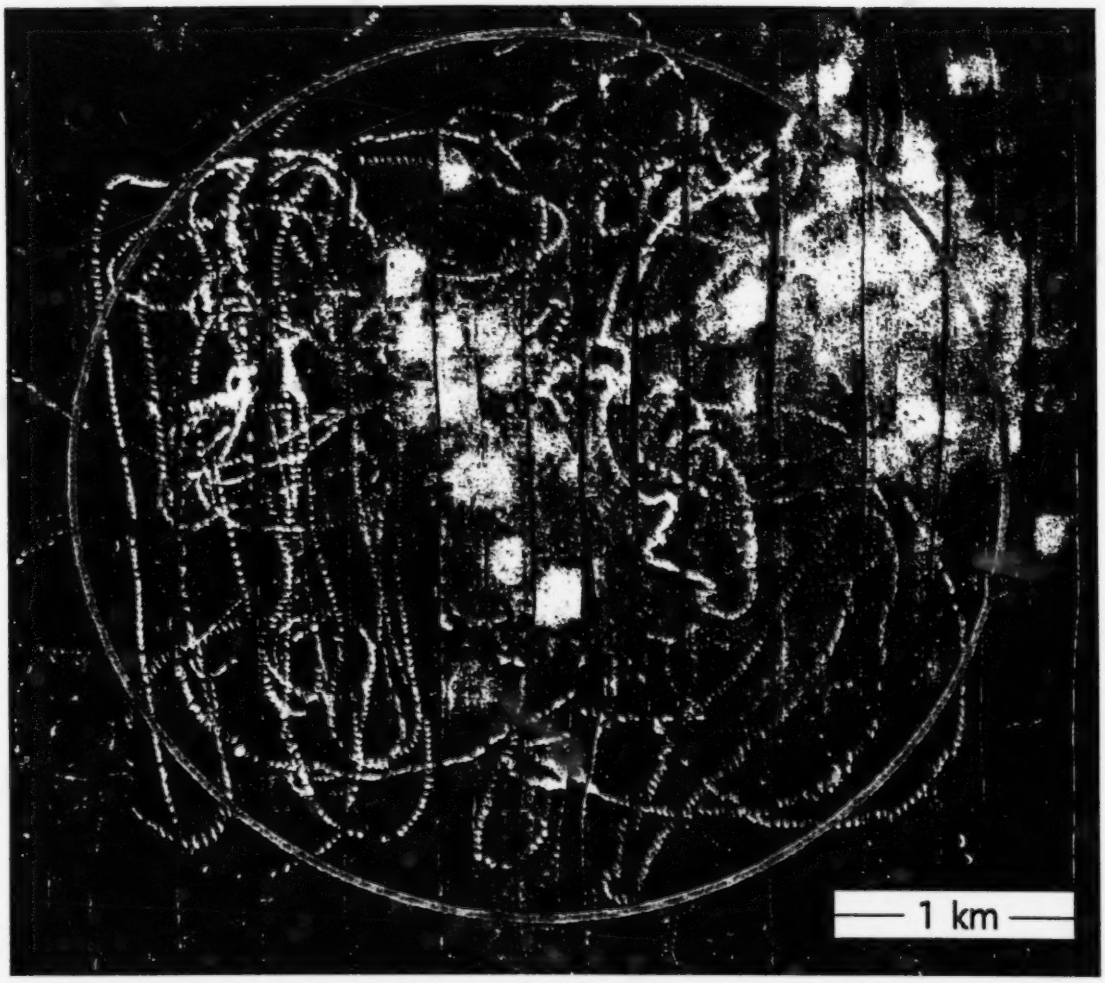


Figure 4. Sidescan sonar mosaic of Point Grey disposal site - October 1996. The image is centered at 49°15.4'N; 123°22.1'W, north at the top of the page. The area within the circle represents the designated disposal area.

Figure 5. Difference map of the sidescan sonar mosaics of Point Grey disposal site. The image is centered at 49°15.4'N; 123°22.1'W, north at the top of the page. The area within the circle represents the designated disposal area.

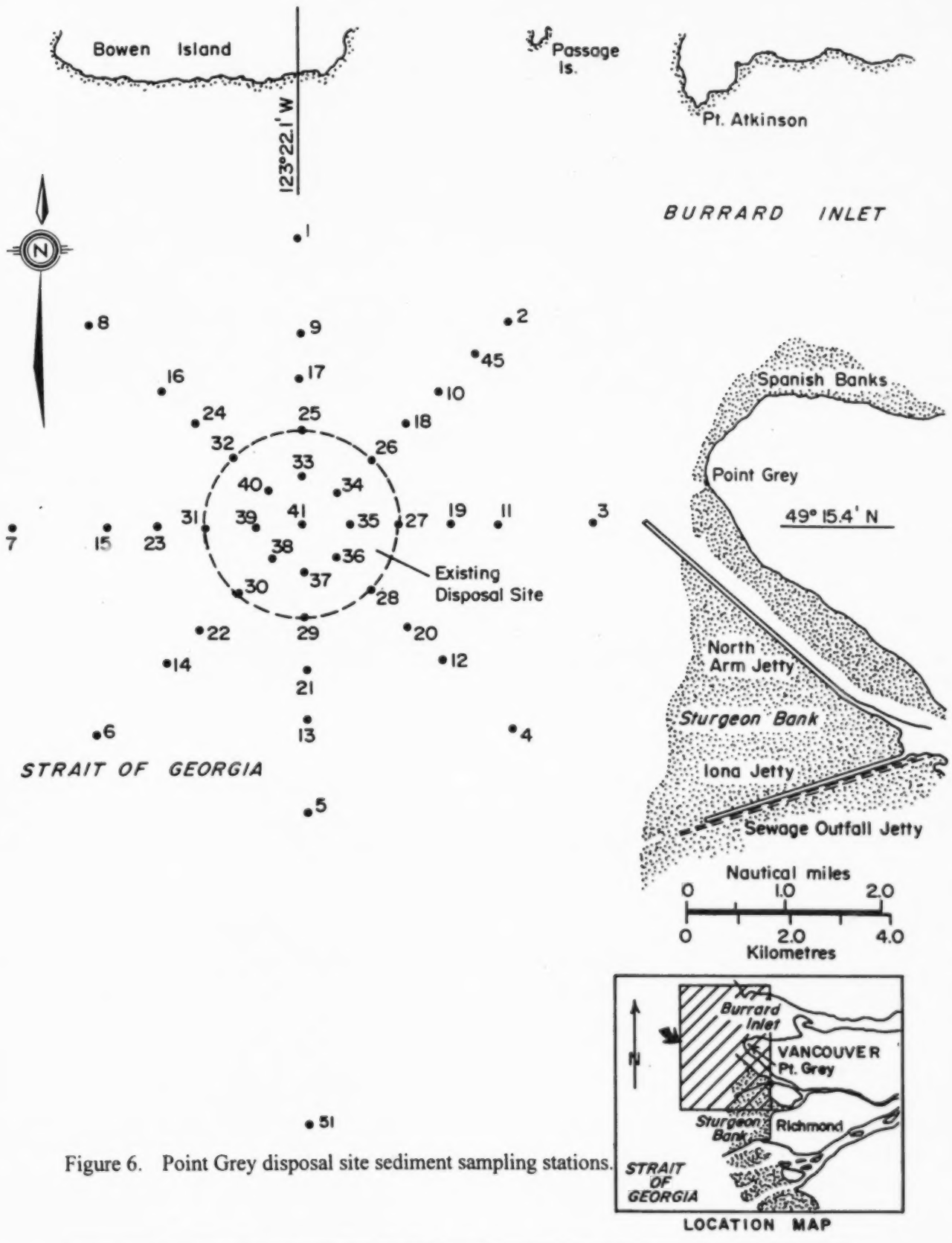


Figure 6. Point Grey disposal site sediment sampling stations.

Table 3. Point Grey sediment chemistry and particle size data - October 1997 survey.

Station	Sediment Chemistry[1]					Particle Size (%)			
	Cd µg/g	Hg µg/g	Cu µg/g	Pb µg/g	Zn µg/g	Gravel > 2.0 mm	Sand 2 - 0.063 mm	Silt 0.063 - 0.004 mm	Clay < 0.004 mm
9	0.26	0.086	46.7	< 8	92	0.2	10.0	45.6	44.2
10	0.25	0.123	51.4	10	97	0.1	4.9	45.8	49.2
11	0.21	0.095	53.4	21	98	0.1	1.6	49.9	48.4
12	0.26	0.083	47.8	27	96	0.0	1.4	50.5	48.2
13	0.16	0.094	43.5	18	91	0.0	0.4	51.5	48.1
14	0.08	0.086	42.6	18	88	0.0	0.8	47.8	51.4
15	0.10	0.104	50.5	21	101	0.0	4.3	40.9	54.8
16	0.20	0.111	56.3	26	104	0.1	3.9	38.6	57.4
17	0.10	0.085	48.7	17	92	0.0	13.7	42.5	43.8
18	0.24	0.083	46.7	10	94	0.0	7.6	44.4	48.1
19	0.21	0.090	47.8	17	95	0.3	1.7	49.9	48.1
20	0.19	0.086	48.9	17	95	0.1	4.0	48.5	47.4
21	0.10	0.087	46.6	24	93	0.1	2.3	49.8	47.8
22	0.18	0.088	46.3	17	94	0.0	2.0	46.5	51.5
23	0.17	0.101	49.9	25	99	0.1	9.5	40.0	50.4
24	0.20	0.096	52.1	10	97	0.0	6.2	39.8	54.0
25	0.32	0.066	40.5	10	85	7.6	24.8	35.5	32.0
26	0.05	0.038	26.3	< 8	49	2.6	53.6	27.1	16.7
27	0.10	0.044	40.4	9	62	22.1	45.9	19.2	12.9
28	0.24	0.072	39.3	17	81	0.6	13.4	46.2	39.9
29	0.10	0.084	44.8	26	90	0.2	7.7	45.2	46.8
30	0.10	0.087	43.6	10	88	1.3	8.4	41.9	48.5
31	0.18	0.094	50.6	28	100	0.5	16.2	38.9	44.4
32	0.27	0.078	46.0	10	88	3.9	14.8	39.7	41.6
33	0.19	0.059	36.4	20	66	8.2	43.3	28.6	19.9
34	0.18	0.043	30.3	20	62	0.1	49.6	29.7	20.6
35	0.17	0.047	31.4	10	65	6.3	59.6	21.9	12.2
36	0.17	0.047	31.4	< 8	62	0.4	56.7	25.0	18.0
37	0.20	0.050	33.4	20	66	0.7	48.0	29.5	21.9
38	0.20	0.053	34.4	10	66	5.6	36.4	31.2	26.8
39	0.20	0.065	40.5	10	76	3.4	35.4	32.7	28.5
40	0.19	0.062	37.1	10	72	3.4	33.4	37.4	25.9
41	0.10	0.026	35.4	< 8	44	15.3	47.1	21.7	15.9

[1] Trace metal analyses are presented as total metals.

5.2 SAND HEADS

Disposal Site:	Sand Heads
Number:	9
Co-ordinates:	49°06.00'N; 123°19.50'W
Depth:	70 metres
Total Quantity disposed Since 1976:	10 785 882 cubic metres

Comments

The Fraser River Dredging Guidelines apply to all projects. Clamshell dredging may be conducted throughout the year, subject to site specific approval. Suction dredges must operate at five metres depth at low tide from March 1 to June 1, and in even-numbered years, are prohibited from April 15 to May 15 during downstream pink salmon migration.

The DFO Habitat Management Unit in New Westminster should be contacted for specific timing restrictions on dredging.

Loadsite Information

Only clean sand, silt and gravel, (no woodwastes) are approved for disposal at the Sand Heads disposal site. The majority of material disposed of at this site originates from Fraser River channel maintenance projects by Public Works and Government Services Canada. In 1997, 876 000 cubic meters of material were disposed of at Sand Heads. Other material sent to Sand Heads typically results from maintenance dredging at load ramps for construction aggregate facilities on the Fraser River.

5.3 PORLIER PASS

Disposal Site:	Porlier Pass
Number:	32
Co-ordinates:	49°00.20'N; 123°29.80'W
Depth:	200 metres
Total Quantity Disposed Since 1976:	166 875 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo (South Coast Division) should be contacted for specific timing restrictions on dredging.

Loadsite Information

In 1997, 13 400 cubic meters of material were sent to the Porlier Pass disposal site resulting from maintenance dredging activities at forest industry operations in Chemainus and Ladysmith.

5.4 FIVE FINGER ISLAND

Disposal Site:	Five Finger Island
Number:	40
Co-ordinates:	49°15.20'N; 123°54.60'W
Depth:	280 metres
Total Quantity Disposed Since 1976:	212 922 cubic metres

Comments

For timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

Loadsite Information

In 1997, 10 300 cubic meters of material resulting from forest related industry operations in Nanaimo were sent to the Porlier Pass disposal site.

Monitoring Information

In October 1997, surface sediment samples were collected from the Five Finger Island disposal site, at five reference locations in the vicinity of the disposal site (stations 10-14) and at a station in Nanaimo Harbour (station 15).

Chemical and particle size data are presented in Table 4. There were no trace metal concentrations above the ICTG limits. Total PAH concentration at station 9 marginally exceeded the ICTG limit; however, the 95% upper confidence limit for TPAH concentration over the entire disposal site is 1.88 µg/g which is below the ICTG limit. Sediment from Nanaimo Harbour exceeded the TPAH criteria.

Samples were collected and analysed for toxicity using the Microtox® solid and liquid phase tests. Test results are presented in Table 5. There was no toxic response observed in sediment from the disposal site or the surrounding reference stations. Test results indicate that the sediment from Nanaimo Harbour was acutely toxic to bacteria.

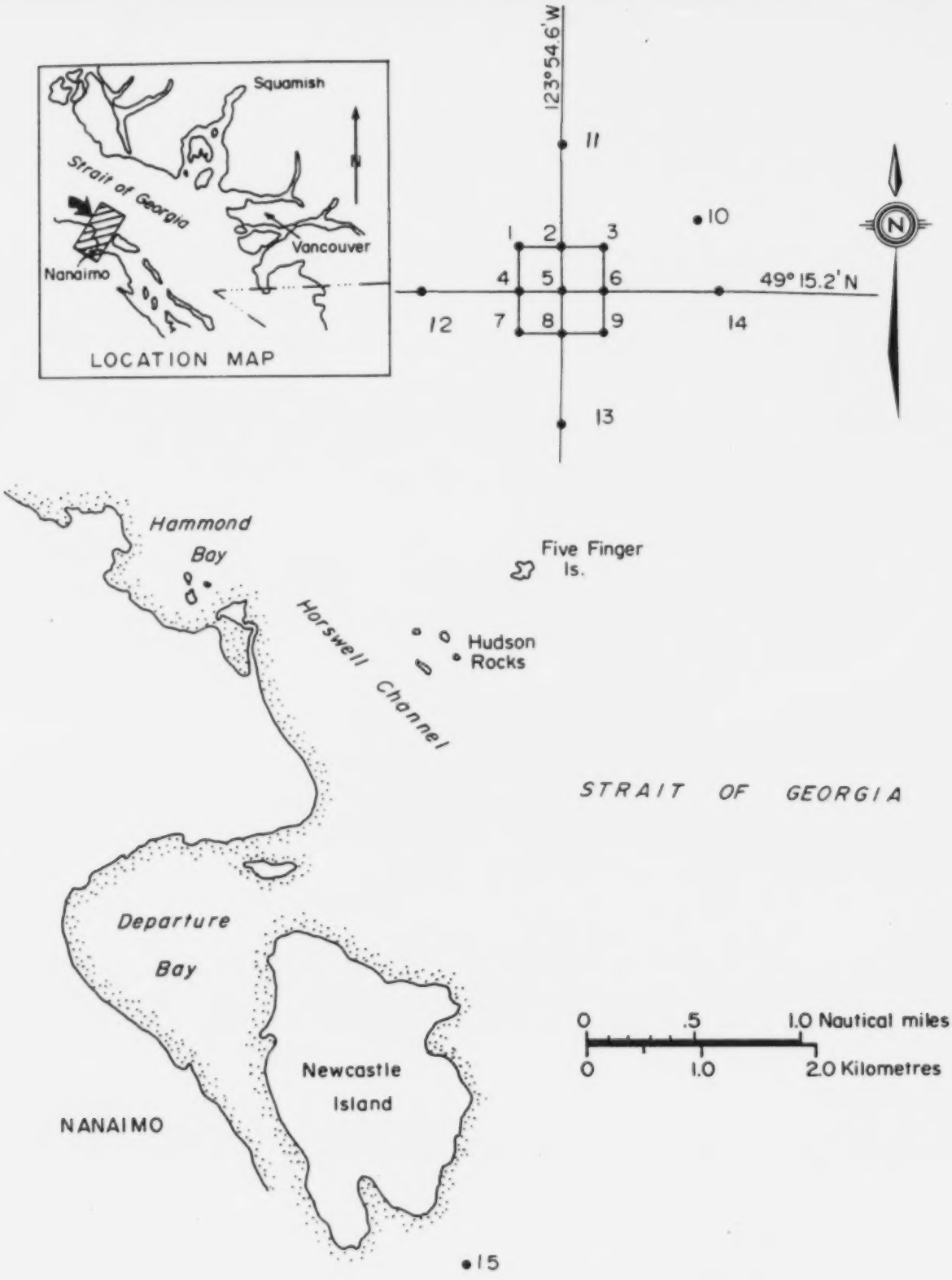


Figure 7. Five Finger Island disposal site sampling stations.

Table 4. Five Finger Island sediment chemistry and particle size data - October 1997 survey.

Station	Sediment Chemistry[2]							% Particle Size			
	Cd µg/g	Hg µg/g	Cu µg/g	Pb µg/g	Zn µg/g	TPAH µg/g	TOC %	Gravel > 2.0 mm	Sand 2 - 0.063 mm	Silt 0.063 - 0.004 mm	Clay < 0.004 mm
1	0.34	0.138	58.3	28	127	1.10	2.51	0.6	8.7	20.3	70.4
2	0.44	0.132	60.1	23	133	0.93	2.56	0.3	1.6	19.9	78.2
3	0.19	0.089	42.1	24	109	0.59	0.99	32.4	29.1	10.8	27.8
4	0.52	0.124	58.3	26	127	1.30	3.68	1.8	4.8	22.8	70.6
5	0.53	0.133	57.8	28	117	1.29	4.21	7.7	12.2	21.9	58.1
6	0.40	0.137	62.2	41	133	1.46	3.19	0.5	9.0	23.4	67.2
7	0.44	0.284	65.0	18	109	1.61	4.40	4.7	15.3	23.6	56.5
8	0.58	0.121	54.3	25	119	1.78	3.25	3.1	15.8	22.3	58.7
9	0.55	0.115	58.3	27	106	* 3.02	3.74	6.4	20.3	23.9	49.4
10	0.40	0.145	61.2	35	135	1.15	2.12	0.2	2.9	22.3	74.7
11	0.45	0.137	62.3	52	141	0.79	1.63	0.0	0.3	18.8	80.9
12	0.46	0.167	61.2	48	139	1.31	2.11	0.0	1.5	20.8	77.6
13	0.24	0.096	44.3	32	83	2.30	3.25	0.8	36.8	23.6	38.8
14	0.17	0.085	40.7	38	105	1.32	1.98	3.5	23.1	20.8	52.6
15	0.30	0.125	57.0	20	53	* 8.55	10.9	2.6	36.9	45.0	15.5

* Indicates sample exceeded ICTG limit.

Table 5. Five Finger Island disposal site Microtox® test results.

Station	Salinity	Liquid Phase Test				Solid Phase Test	
		% Screen Test		IC50 (%)		IC50 (%)	IC50 (%)
		5 min	15 min	5 min	15 min	Wet	Dry
1	30	no effect	no effect	NP	NP	0.49	0.18
2	30	no effect	no effect	NP	NP	0.37	0.13
3	30	no effect	no effect	NP	NP	0.59	0.30
4	30	no effect	no effect	NP	NP	0.81	0.31
5	30	no effect	no effect	NP	NP	0.36	0.14
6	30	no effect	no effect	NP	NP	0.55	0.22
7	31	no effect	no effect	NP	NP	0.57	0.24
8	30	no effect	no effect	NP	NP	0.46	0.21
9	30	no effect	no effect	NP	NP	0.60	0.26
10	31	no effect	no effect	NP	NP	0.82	0.32
11	30	no effect	no effect	NP	NP	0.68	0.26
12	30	no effect	no effect	NP	NP	0.73	0.27
13	30	no effect	no effect	NP	NP	0.70	0.35
14	30	no effect	no effect	NP	NP	0.63	0.30
15	29	* 79.4	* 88.9	* 26.2	* 11.6	2.73	1.88

"no effect" indicates less than 10% light decrease

NP = not performed because of "no effect" result following 100% screen test.

* Indicates a toxic response.

[2] Trace metal analyses are presented as total metals.

5.5 FRENCH CREEK

Disposal Site:	French Creek
Number:	44
Co-ordinates:	49°22.50'N; 124°19.00'W
Depth:	200 metres
Total Quantity Disposed Since 1976:	30 500 cubic metres

Comments

For specific timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

Loadsite Information

The French Creek disposal site was last used in 1984.

Monitoring Information

In October 1997, surface sediment samples were collected from stations 4, 5 and 6 at the French Creek disposal site (Figure 8). Chemical and particle size analyses are presented in Table 6. No chemical concentrations exceeded the ICTG limits.

A composite of grabs at all three stations was submitted for biological testing using the Microtox® test. Biological test results are presented in Table 7. No toxic responses were observed in sediment from this disposal site.

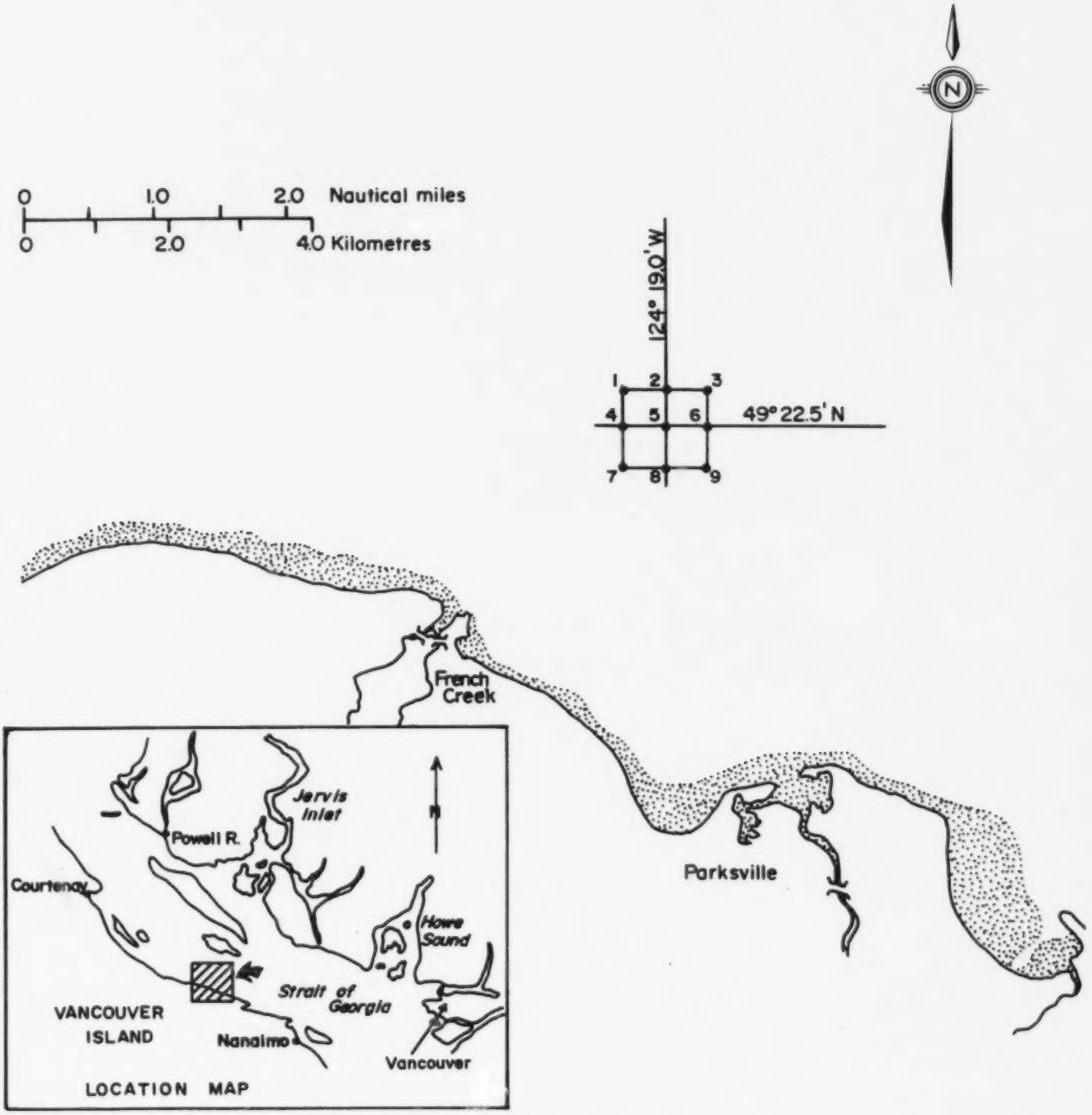


Figure 8. French Creek disposal site sampling stations.

Table 6. French Creek sediment chemistry and particle size data - October 1997 survey.

Station	Sediment Chemistry[3]							% Particle Size			
	Cd µg/g	Hg µg/g	Cu µg/g	Pb µg/g	Zn µg/g	TPAH µg/g	TOC %	Gravel > 2.0 mm	Sand 2 - 0.063 mm	Silt 0.063 - 0.004 mm	Clay < 0.004 mm
4	0.19	0.086	59.1	40	92			12.5	13.1	32.8	41.7
5	0.41	0.106	59.3	30	112			0.0	5.7	33.8	60.5
6	0.45	0.117	65.8	44	128			2.0	6.5	29.5	62.1
Composite (4,5,6)	0.33	0.093	56.4	34	102	0.40	1.87	2.2	11.8	35.5	50.5

Table 7. French Creek disposal site Microtox® test results.

Station	Salinity	Liquid Phase Test				Solid Phase Test	
		% Screen Test		IC50 (%)		IC50 (%)	IC50 (%)
		5 min	15 min	5 min	15 min	Wet	Dry
4,5,6	30	no effect[1]	no effect	NP[2]	NP	1.11	0.48

[1] "no effect" indicates less than 10% light decrease

[2] NP = not performed because of "no effect" result following 100% screen test.

[3] Trace metal analyses are presented as total metals.

5.6 COMOX (CAPE LAZO)

Disposal Site:	Comox (Cape Lazo)
Number:	48
Co-ordinates:	49°41.70'N; 124°44.50'W
Depth:	190 metres
Total Quantity Disposed Since 1976:	20 117 cubic metres

Comments

For specific timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

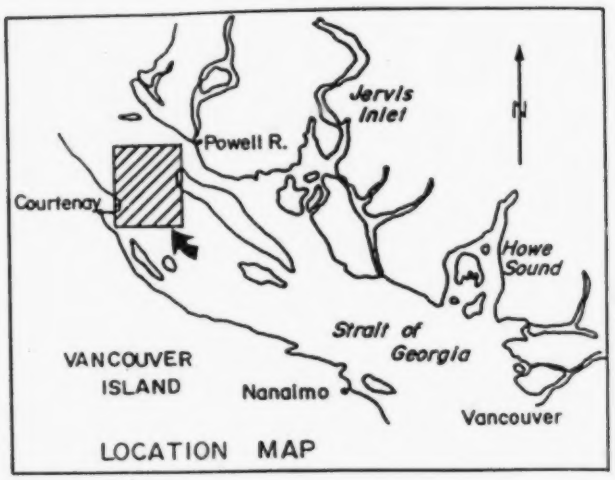
Loadsite Information

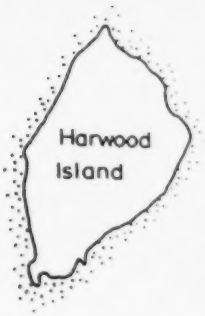
In 1997, 4 000 cubic meters of material were disposed of at the Comox disposal site. This material originated from maintenance dredge activities in Courtenay River.

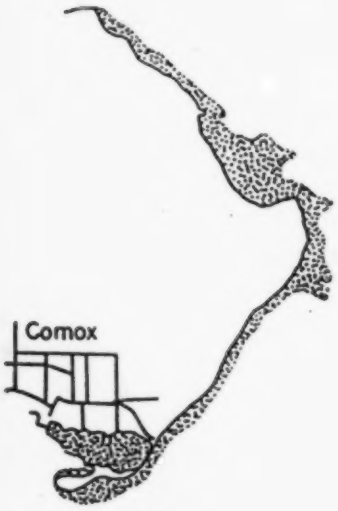
Monitoring Information

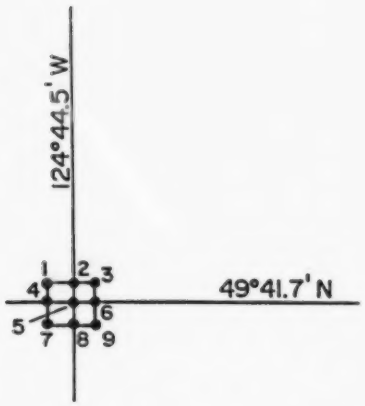
A monitoring survey was conducted at the Comox disposal site in October 1997. Due to extreme weather and sea conditions, surface grab samples were collected only at stations 5 and 6. Chemical and particle size data are presented in Table 8. No chemical parameters exceeded the ICTG limits.

A composite of sediment from stations 5 and 6 was submitted for toxicological analysis using the solid and liquid phase Microtox® tests. Results of this test are presented in Table 9. No toxicity was observed in either of the tests.









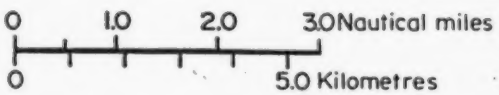


Figure 9. Comox (Cape Lazo) disposal site sampling stations.

Table 8. Comox sediment chemistry and particle size data - October 1997 survey.

Station	Sediment Chemistry[4]							% Particle Size			
	Cd µg/g	Hg µg/g	Cu µg/g	Pb µg/g	Zn µg/g	TPAH µg/g	TOC %	Gravel > 2.0 mm	Sand 2 - 0.063 mm	Silt .063 - .004 mm	Clay < 0.004 mm
5	0.26	0.084	62.4	21	79			0.4	28.1	35.9	35.6
6	0.26	0.076	59.4	17	86			3.8	26.1	27.0	43.1
Composite (5,6)	0.30	0.063	49.9	10	76	0.24	1.53	1.4	23.8	33.2	41.6

Table 9. Comox disposal site Microtox® test results.

Station	Salinity	Liquid Phase Test				Solid Phase Test	
		% Screen Test		IC50 (%)		IC50 (%)	IC50 (%)
		5 min	15 min	5 min	15 min	Wet	Dry
5,6	30	no effect[1]	no effect	NP[2]	NP	1.42	0.65

[1] "no effect" indicates less than 10% light decrease

[2] NP = not performed because of "no effect" result following 100% screen test.

[4] Trace metal analyses are presented as total metals.

5.7 MALASPINA STRAIT

Disposal Site:	Malaspina Strait
Number:	49
Co-ordinates:	49°45.00'; 124°27.00'W
Depth:	320 metres
Total Quantity Disposed Since 1976:	523 968 cubic metres + 6 000 tonnes

Comments

For timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

Loadsite Information

In 1997, 14 718 cubic metres of material resulting from maintenance dredging activities at the MacMillan Bloedel mill in Powell River and 5 650 cubic metres of clean excavated native till from Jervis Inlet were sent to the Malaspina Strait disposal site.

5.8 THORNBROUGH CHANNEL

Disposal Site:	Thornbrough Channel
Number:	64
Co-ordinates:	49°31.00'N; 123°28.30'W
Depth:	220 metres
Total Quantity Disposed Since 1976:	70 861 cubic metres

Comments

For complete timing restrictions on dredging, contact the DFO Habitat Management Unit in New Westminster.

Loadsite Information

In 1997, maintenance dredging at forest industry operations in Howe Sound resulted in 4 000 cubic meters of material sent to the Thornbrough Channel disposal site.

5.9 WATTS POINT

Disposal Site:	Watts Point
Number:	65
Co-ordinates:	49°38.50'N; 123°14.00'W
Depth:	230 metres
Total Quantity Disposed Since 1976:	487 116 cubic metres

Comments

Dredging is prohibited from April 01 to June 01 of any year in order to protect juvenile salmonids migrating downstream in Mill Creek. For further timing restrictions on dredging, contact the DFO Habitat Management Unit in New Westminster.

Loadsite Information

In 1997, 10 100 cubic meters of material resulting from maintenance dredging at forest industry operations in Howe Sound were disposed of at the Watts Point disposal site.

5.10 THORMANBY ISLAND

Disposal Site:	Thormanby Island
Number:	114
Co-ordinates:	49°27.50'N; 124°04.50'W
Depth:	384 metres
Total Quantity Disposed Since 1976:	6 185 cubic metres

Comments

For specific timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

Loadsite Information

The Thormanby Island disposal site was last used in 1995.

Monitoring Information

Surface sediment samples were collected at stations 4 and 5, and a single core sample was taken at station 5. Results of chemical and particle size analyses are presented in Table 10. Trace metal concentrations in surface sediment were within ICTG limits, with the exception of a marginally elevated cadmium concentration at 90 cm in the core sample.

A composite of sediment collected at stations 4 and 5 was submitted for biological testing using the solid and liquid phase Microtox® test. The composite sample was not toxic to the bacteria in either test. Results are presented in Table 11.

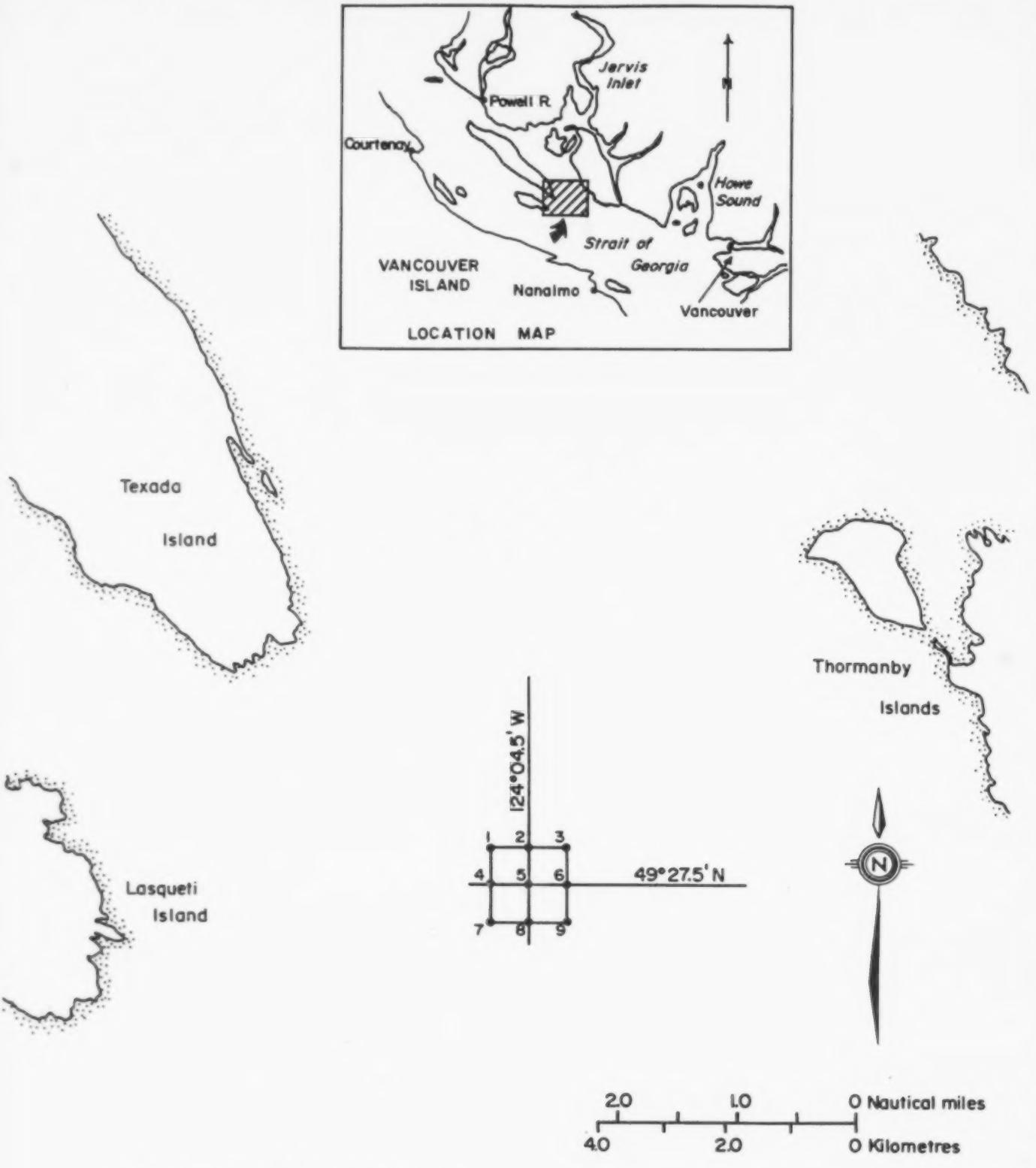


Figure 10. Thormanby Island disposal site sampling stations.

Table 10. Thormanby Island sediment chemistry and particle size data - October 1997 survey.

Station	Sediment Chemistry[5]							% Particle Size			
	Cd µg/g	Hg µg/g	Cu µg/g	Pb µg/g	Zn µg/g	TPAH µg/g	TOC %	Gravel > 2.0 mm	Sand 2 - 0.063 mm	Silt 0.063 - 0.004 mm	Clay < 0.004 mm
4	0.43	0.123	63.2	33	142			0.1	0.1	21.7	78.0
5	0.40	0.126	60.2	33	140			0.0	1.3	24.4	74.3
10-20 cm	0.40	0.142	60.3	33	150			0.5	0.4	21.3	77.8
30-40 cm	0.60	0.095	50.0	10	101			0.0	0.3	19.1	80.6
60-70 cm	0.46	0.064	47.5	19	100			0.0	0.2	19.6	80.2
90-100 cm	* 0.64	0.062	46.3	23	99			0.0	0.2	19.9	79.9
Composite (4,5)	0.48	0.151	59.7	32	151	0.77	1.60	0.0	0.4	20.7	78.9

* Indicates concentration above ICTG limit.

Table 11. Thormanby Island disposal site Microtox® test results.

Station	Salinity	Liquid Phase Test				Solid Phase Test	
		% Screen Test		IC50 (%)		IC50 (%)	IC50 (%)
		5 min	15 min	5 min	15 min	Wet	Dry
4,5	30	no effect[1]	no effect	NP[2]	NP	0.84	0.32

[1] "no effect" indicates less than 10% light decrease

[2] NP = not performed because of "no effect" result following 100% screen test.

[5] Trace metal analyses are presented as total metals.

5.11 JOHNSTONE STRAIT - HICKEY POINT

Disposal Site:	Johnstone Strait - Hickey Point
Number:	119
Co-ordinates:	50°27.80'N; 126°04.80'W
Depth:	270 metres
Total Quantity Disposed Since 1976:	160 187 cubic metres + 40 tonnes

Comments

For specific timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

Loadsite Information

In 1997, 6 000 cubic meters of dredged material from MacMillan Bloedel operations in Eve River and Kelsey Bay were disposed of at this site.

5.12 JOHNSTONE STRAIT - HANSON ISLAND

Disposal site:	Johnstone Strait - Hanson Island
Number:	120
Co-ordinates:	50°33.50'N; 126°48.00'W
Depth:	350 metres
Total Quantity Disposed Since 1976:	192 156 cubic metres

Comments

For specific timing restrictions on dredging, contact the DFO Habitat Management Unit in Nanaimo (South Coast Division).

Loadsite Information

In 1997, 15 600 cubic meters of dredged material were disposed of at the Hanson Island disposal site. This material originated from forest industry operations in Port McNeill, Beaver Cove, Eve River, and Kelsey Bay.

5.13 PWC 5

Disposal Site:	PWC 5
Number:	154
Co-ordinates:	49°09.40'N; 122°59.70'W
Depth:	10 metres
Total Quantity Disposed Since 1976:	1 234 797 cubic metres

Comments

The Fraser River Dredging Guidelines apply to all projects. Clamshell dredging may operate year round subject to site-specific approval. For specific timing restrictions on dredging, contact the DFO Habitat Management Unit in New Westminster.

Loadsite Information

PWC 5 disposal site is exclusively used for Fraser River channel maintenance projects. In 1997, 13 200 cubic meters of Fraser River sediment were disposed of at PWC 5.

5.14 SNAKE ISLAND

Disposal Site:	Snake Island
Number:	161
Co-ordinates:	49°13.30'N; 123°53.10'W
Depth:	32 metres
Total Quantity Disposed Since 1976:	2 400 tonnes

Comments

This disposal site was designated in 1997 for the disposal of a vessel.

Loadsite Information

The *Saskatchewan*, a decommissioned naval destroyer, was sunk near Snake Island in June 1997 by the Artificial Reef Society of British Columbia. All floatables, fuel, oil, hydraulic fluids, lubricants and other petroleum-based products were removed from the vessel prior to sinking.

6.0 REFERENCES

Publications

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Websites

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APPENDICES

APPENDIX I

Interim Contaminant Testing Guidelines for Ocean Disposal Pacific and Yukon Region (1997 March)

INTERIM CONTAMINANT TESTING GUIDELINES FOR OCEAN DISPOSAL

Pacific and Yukon Region (1997 March)

In response to growing concern over the biological implications of contaminants in marine sediments along the Canadian coastline, Environment Canada (EC), Pacific and Yukon Region, in consultation with the Regional Ocean Disposal Advisory Committee (RODAC), has developed the following guidelines for sampling, analysis and reporting associated with proposed ocean disposal activities.

Under Schedule III, Part III of the *Canadian Environmental Protection Act* (CEPA), EC must consider the availability of practical alternative disposal options. To satisfy this requirement the applicant must provide a written record of the decision making process used in selecting ocean disposal as the alternative of choice for disposal of materials. Disposal at sea is only permitted for materials where it is the environmentally preferable and practical alternative.

To assess the potential for environmental impacts of ocean disposal, EC will require chemical analyses to be performed on any material where there is a lack of chemical data, or a reason to believe that contaminants such as selected trace metals or organics are present. The minimum number of samples and the analyses required is specified in the following tables; the number of samples and the analyses required may be increased by EC in some instances. A proposed sampling program should be developed by the applicant, based on information provided in the following tables, and submitted to EC for approval prior to commencement of loading/ocean disposal activities.

Materials found to contain substances of concern at or higher than the regulated or guideline concentrations identified in the following tables may be considered for ocean disposal under section 71(3) of CEPA if they pass a series of biological tests. A tiered assessment approach using biological testing is used for this determination. The procedures for these tests are described in the document entitled "Interim Guidance for Application of Rapidly Rendered Harmless (RRH) and Trace Contaminants", which is available upon request from EC. Ocean disposal options such as capping, containment, and side-casting, suggested by an applicant, will be considered by EC, but their acceptance will be conditional on compliance with RRH protocols.

SAMPLING AND ANALYSIS REQUIREMENTS

The following pages identify the minimum sampling and analytical requirements for dredged and excavated materials based on the size of the project, as well as rejection/ screening limits currently used by EC. Sampling requirements will be tailored on a site specific basis at the discretion of EC and analysis of other parameters may be requested when there is reason to believe that other contaminants are present.

MINIMUM REQUIREMENTS FOR DREDGED MATERIALS

SAMPLING REQUIREMENTS

All samples are analysed for minimum requirements.

Project Quantity (m^3)	Permit Type	Minimum # of Samples	Type of Sampling
0 - 4,000	General *	3 (1) **	• surface sampling prior to loading
0 - 10,000	Site-Specific	3 (1)	• surface sampling prior to loading
10,000 - 30,000	Site-Specific	3 (1) 3 (1) **or** 6 (2)	• surface sampling prior to loading • sampling to depth prior to loading • surface sampling prior to loading • may require additional sampling during dredging
30,000 - 60,000	Site-Specific	4 (2) 4 (2)	• surface sampling prior to loading • sampling to depth prior to loading
>60,000	Site-Specific	• sampling requirements to be determined on a project specific basis	

* General Permits are multi-loadsite permits issued to applicants, and are specific to disposal from maintenance dredging projects of less than 4 000 cubic metres.

** The brackets indicate the number of *composite* samples to be analysed initially for dioxins/furans, if requested by EC.

MINIMUM ANALYSIS REQUIREMENTS

	Parameter	Limit of Detection
Trace Metals	Mercury (Hg)	0.2 µg/g
	Cadmium (Cd)	0.2 µg/g
Organics	TPAH	0.1 µg/g
Other	TOC	
	Particle Size	

For PAH, the analytical methodology and quality assurance protocol must conform to that outlined in the 'Interim Quality Assurance Guidelines for Determination of Polynuclear Aromatic Hydrocarbons in Marine Sediments for Ocean Disposal', a copy of which is available from EC.

Should the site history reveal cause for environmental concern, an increased number of samples and/or analysis of other metals and/or organics may be requested. Additional parameters may include the following:

	Parameter	Limit of Detection
Trace Metals	Copper (Cu)	10 µg/g
	Zinc (Zn)	10 µg/g
	Arsenic (As)	10 µg/g
	Chromium (Cr)	10 µg/g
	Nickel (Ni)	10 µg/g
	Lead (Pb)	10 µg/g
Organics	PCB	0.05 µg/g
	PCP	0.05 µg/g
	Dioxins/furans	10 pg/g for T_4CDD

The analysis results are to be reported on a dry weight basis with detection limits less than or equal to those stated above. The precision of the test method should be indicated by reporting analyses on five replicate sub-samples on 10% of the trace metal samples, and two replicate sub-samples on 20% of the organics samples, with a minimum of one replicated sample. Sub-sampling should be done following homogenizing but prior to digestion of the sample and the replicates should not be run consecutively. The accuracy of the test method should be indicated by reporting the results of certified reference materials analysed at the same time as the test samples.

For dioxin/furan, the analytical methodology and quality assurance protocol must conform to that outlined in the 'Internal Quality Assurance Requirements for Analysis of Dioxins in Environmental Samples', a copy of which is available from EC.

MINIMUM REQUIREMENTS FOR EXCAVATION MATERIALS*

* "General" Permits for excavation spoils are restricted to the loading and ocean disposal of *undisturbed, native material*. For other excavated materials, a site specific permit will be required.

SAMPLING REQUIREMENTS

Project Quantity (m^3)	Minimum Number of Samples	Type of Sampling
0 - 10,000	3	• composite of surface native material to one metre depth
10,000 - 30,000	6	• composite of surface native material to one metre depth
30,000 - 60,000	8	• composite of surface native material to one metre depth
> 60,000	sampling requirements to be determined on a project specific basis	

MINIMUM ANALYSIS REQUIREMENTS

	Parameter	Limit of Detection
Trace Metals	Mercury (Hg)	0.2 µg/g
	Cadmium (Cd)	0.2 µg/g
	Lead (Pb)	10 µg/g
	Copper (Cu)	10 µg/g
	Zinc (Zn)	10 µg/g
	Arsenic (As)	10 µg/g
	Chromium (Cr)	10 µg/g
	Nickel (Ni)	10 µg/g
Organics	TPAH	0.1 µg/g
Other	TOC	
	Particle Size	

Should the site history reveal cause for environmental concern, an increased number of samples and/or analysis of other metals and/or organics may be requested.

The analysis results are to be reported as stipulated under Table 1. Minimum requirements for dredged materials.

REJECTION/SCREENING LIMITS

Parameter	Rejection/Screening Limit (µg/g dry weight)
Cadmium	0.6 µg/g
Mercury	0.75 µg/g
Arsenic Copper Zinc Beryllium Chromium Nickel Vanadium Lead	* 0.1 % or more by weight or 1000 µg/g
Chlorophenols (PCP) (penta and tetra isomers)	1.0 µg/g
Polychlorinated biphenyls (PCB)	0.1 µg/g
PAH (total)	2.5 µg/g
Dioxin/Furan	"quantifiable" 2,3,7,8 TCDD

* These levels are defined as "significant amounts" as agreed to by Canada as a signatory to the London Convention (LC); if exceeded, special care measures are required for disposal. *EC considers these levels as general guidelines only and may impose more stringent limits.*

STEPS REQUIRED FOR COLLECTING SAMPLES AND SUBMITTING ANALYTICAL DATA

Prepare the following information:

1) a location map for the dredge/excavation site with the the street address of the proposed excavation or dredge site,
2) a site map showing the proposed excavation or dredge site relative to known landmarks and/or streets,
3) a list of any known possible contaminant input sources in the vicinity of the proposed works,
4) a written record of the decision making process used in selecting ocean disposal as the preferred materials disposal option, explaining why other disposal methods are not being used,
5) a site use history for the site from which the material destined for ocean disposal will originate, and
6) a proposed sampling plan of the site showing the proposed sampling locations, and a list of proposed analyses. The proposed sampling plan should be developed based on information presented in this document. Assistance in designing a sampling program can be provided by EC, Pacific and Yukon Region. *The sampling program must be approved prior to taking the samples.*

The information identified above should be sent to EC. If the project does not qualify for completion under the terms and conditions of a "General" permit, this information should be submitted with a completed ocean disposal application form. For information on how to apply, please contact EC.

If the project qualifies for completion under a "General" ocean disposal permit, this information must be submitted to EC with a covering letter describing the proposed activities in detail, and the proposed schedule for the work. Upon completion of the sampling and analyses program, the test data, together with all QA/QC data as identified in the foregoing information, must be sent to EC.

No work may proceed under a "General" permit until written approval for the specific site has been received from EC, and a copy of the approval letter is posted at the work site.

For further information on this document, or any other matter relating to ocean disposal, please contact the following:

Dixie Sullivan	(604) 666-2730
Vincent Haugland	(604) 666-0724
Cathy Schnider	(604) 666-2685

GENERAL GUIDE TO SOIL AND SEDIMENT SAMPLE COLLECTION

Containers for the samples should be obtained from the laboratory contracted to conduct the required analyses. Avoid unnecessary contact with clean glassware and utensils. A clean stainless steel or teflon spoon or scoop is ideal for transferring samples. Handle containers by the outsides only. Do not touch the inside of the jar, or teflon (or foil) liners, and use spoons or scoops by the handles only. When removing a foil or teflon liner and lid from a jar, remove as one piece and put down on a piece of foil or other clean surface while filling the jar.

If using a grab sampler, remove the water from the surface of the grab, taking care not to disturb the contents if possible. Use the clean scoop to remove a portion of the sediment from the middle of the sampler down to the depth of the material caught in the grab. The material in the sample jar should be representative of the material to be loaded for ocean disposal.

Alternatively, the sample may be taken by removing the lid, holding the jar by the sides and scooping the sample from the sediment without the use of other utensils. The threads of the jar may then be wiped with a paper towel before replacing the lid. Do not fill the jar more than about 3/4 full, allowing plenty of room for mixing/stirring, and expansion during freezing.

When the sample is in the jar, replace the teflon/foil liner and lid, and label the jar with project identification, the sampling site number, and the date.

To clean the sampling spoon or grab in-between samples, wipe with a paper towel to remove any solids, then rinse with water. Clean the tray in this manner as required.

If three samples are required for analysis, three small jars of sediment should be taken for *each* sampling station, for a total of nine jars. The three jars per sample will be composited by the analytical lab by taking equal aliquots of sample from each jar for a single analysis of most parameters of concern. The samples may be further composited for other testing as required but would otherwise be maintained as discrete samples.

Keep the samples in a refrigerator or on ice for short term storage (1-2 days); freeze the sample as soon as possible or store over dry ice for long term storage. The laboratory responsible for the analyses should be asked to freeze the samples after removal of sufficient material to complete the required analyses. These samples should remain frozen until the permit, or approval under a general permit, has been issued by EC.

APPENDIX II

Ocean Disposal Site Summaries

Disposal Site History Report

For Disposal Activities Between 1997/01/01 and 1997/12/31

Disposal Site Point Grey
Number 1
Latitude 49°15.40'N
Longitude 123°22.10'W
Depth (m) 210

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3155	FR-ACORN-PRIMEX	24-Feb-97	1,500 m3
	3155	FRNA-WEST COAST CELLUFIBRE	15-Apr-97	2,500 m3
	3156	FR-CIPA LUMBER	12-Jan-97	1,000 m3
	3156	FR-DELTA CEDAR	16-Feb-97	1,750 m3
	3156	FRNA-WESTERN WHITEWOOD	03-Mar-97	5,500 m3
	3156	VAN HBR-COAL HARBOUR MARINA	05-Mar-97	45 m3
	3156	FRNA-TERMINAL SAWMILL	08-Mar-97	2,500 m3
	3156	FRNA-RICHMOND PLYWOOD	15-Mar-97	6,000 m3
	3156	FR-WESTMINSTER TERMINALS	24-Mar-97	1,500 m3
	3156	FRNA-VAN SAWMILL	28-Mar-97	4,000 m3
	3156	FR-CIPA LUMBER	12-Apr-97	1,000 m3
	3158	FRNA-CANADIAN WHITE PINE	22-Apr-97	5,200 m3
	3165	VAN HBR-FLAVELLE CEDAR	15-Jan-97	12,000 m3
	3168	VAN HBR-F&N LOG SORT	24-Feb-97	3,058 m3
	3169	FRNA-GOLDWOOD IND	22-Feb-97	1,200 m3
	3169	FRNA-SKYLINE MARINA	25-Feb-97	4,050 m3
	3169	FR-PACIFIC CUSTOM LOG SORT	11-May-97	1,200 m3
	3169	FRNA-SUNSHINE TERMINALS	17-Nov-97	3,150 m3
	3171	FR-LINDAL CEDAR	04-Oct-97	1,200 m3
	3174	FR-ACORN-PRIMEX	09-Aug-97	2,000 m3
	3174	FR-MACKENZIE MILLS	06-Sep-97	4,000 m3
	3174	FR-WINVAN PAVING	10-Sep-97	2,000 m3
	3174	FRNA-WEST COAST CELLUFIBRE	06-Nov-97	4,000 m3
	3176	FR-DELTA CEDAR	01-Jul-97	6,500 m3
	3176	FR-CIPA LUMBER	09-Aug-97	1,500 m3
	3176	FRNA-WESTERN WHITEWOOD	11-Aug-97	4,500 m3
	3176	FRNA-RICHMOND PLYWOOD	21-Aug-97	3,200 m3
	3176	FR-MACDONALD CEDAR	28-Aug-97	4,000 m3
	3176	FR-COAST MOUNTAIN HARDWOODS/NOR	02-Sep-97	4,000 m3
	3176	FR-HAMMOND CEDAR	11-Oct-97	4,000 m3

Dredge	3176	FRNA-GOLDWOOD IND	18-Oct-97	2,000 m3
	3176	FRNA-SCOTT PAPER LTD	30-Oct-97	3,000 m3
	3176	FRNA-SILVERTREE SAWMILLS	08-Nov-97	4,000 m3
	3176	FRNA-MAINLAND SAWMILL	13-Nov-97	4,000 m3
	3176	FR-FORT LANGLEY CEDAR	20-Nov-97	2,000 m3
	3176	VAN HBR-FLAVELLE CEDAR	22-Dec-97	1,000 m3
	3178	FR-S&R SAWMILLS	11-Aug-97	61,180 m3
	3179	FRNA-CANADIAN WHITE PINE	21-Jul-97	7,700 m3
	3179	FRNA-MB-NW	29-Jul-97	8,850 m3
	3181	FR-FRASER PULP CHIP	24-Oct-97	4,000 m3
	3181	FR-TEAL CEDAR	03-Nov-97	3,064 m3
	3187	FR-MILL & TIMBER	22-Dec-97	7,500 m3
			Total Dredge Quantity:	206,347 m3
Excavation	3161	LOWER MAINLAND-CONAG-NORTH	22-Feb-97	6,500 m3
	3163	LOWER MAINLAND-BEL	01-Jan-97	204,888 m3
	3172	LOWER MAINLAND-CONAG-NORTH	15-Jan-97	41,700 m3
	3177	LOWER MAINLAND-BEL	03-Jul-97	159,186 m3
			Total Excavation Quantity:	412,274 m3

Disposal Site Sand Heads
Number 9
Latitude 49°06.00'N
Longitude 123°19.50'W
Depth (m) 70

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3150	FR-MAINTENANCE	14-Jan-97	828.492 m3
	3156	FR-TEXADA LIME	03-Mar-97	1.500 m3
	3168	FR-OCEAN CONSTRUCTION	29-Jul-97	765 m3
	3171	FR-MAINTENANCE	08-Oct-97	48.000 m3
	3176	FR-CONAG-SURREY	25-Aug-97	3.000 m3
	3176	FR-TILBURY CEMENT	10-Sep-97	4.000 m3
	3182	FR-RIVTOW-ALASKA WAY	06-Oct-97	3.700 m3
			Total Dredge Quantity:	889.457 m3

Disposal Site	Porlier Pass
Number	32
Latitude	49°00.20'N
Longitude	123°29.80'W
Depth (m)	200

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3169	VAN IS-CHEMAINUS-MB-DRYSORT	20-Jul-97	1,800 m3
	3169	VAN IS-BURLEITH ARM-CPFP	24-Jul-97	1,200 m3
	3169	VAN IS-LADYSMITH-CPFP-DRYSORT	24-Jul-97	1,200 m3
	3169	VAN IS-CHEMAINUS-SAWMILL	03-Aug-97	2,400 m3
	3169	VAN IS-CHEMAINUS RIVER FLATS	06-Aug-97	2,400 m3
	3175	VAN IS-TIMBERWEST-SHOAL ISL	06-Aug-97	1,500 m3
	3175	VAN IS-LADYSMITH-DOMANS	08-Aug-97	2,900 m3
			Total Dredge Quantity:	13,400 m3

Disposal Site Five Finger Island
Number 40
Latitude 49°15.20'N
Longitude 123°54.60'W
Depth (m) 280

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3175	VAN IS-DOMANS-DUKE PT	04-Jul-97	3,200 m3
	3175	VAN IS-MB-ISLAND PHOENIX	14-Jul-97	500 m3
	3175	VAN IS-HARMAC	27-Oct-97	2,500 m3
	3185	VAN IS-HARMAC-PHIPPS LANDING	15-Nov-97	4,100 m3
			Total Dredge Quantity:	10,300 m3

Disposal Site	Comox (Cape Lazo)
Number	48
Latitude	49°41.70'N
Longitude	124°44.50'W
Depth (m)	190

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3176	VAN IS-PRIMEX-FIELD SAWMILLS	01-Aug-97	4,000 m3
			Total Dredge Quantity:	4,000 m3

Disposal Site	Malaspina Strait
Number	49
Latitude	49°45.00'N
Longitude	124°27.00'W
Depth (m)	320

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3183	POWELL RIVER	11-Oct-97	13,518 m3
	3189	STILLWATER	12-Dec-97	1,200 m3
			Total Dredge Quantity:	14,718 m3
Excavation	3186	JERVIS INLET	12-Nov-97	5,650 m3
			Total Excavation Quantity:	5,650 m3

Disposal Site	Thornbrough Channel
Number	64
Latitude	49°31.00'N
Longitude	123°28.30'W
Depth (m)	220

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3176	HOWE SD-TERMINAL FORESTS	08-Oct-97	4,000 m3
			Total Dredge Quantity:	4,000 m3

Disposal Site	Watts Point
Number	65
Latitude	49°38.50'N
Longitude	123°14.00'W
Depth (m)	230

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3169	HOWE SD-PORT MELLON	10-Aug-97	600 m3
	3176	HOWE SD-SQUAMISH LUMBER	11-Oct-97	4,000 m3
	3176	HOWE SD-EMPIRE LOGGING	14-Oct-97	1,500 m3
	3176	HOWE SD-WOODFIBRE	15-Oct-97	4,000 m3
			Total Dredge Quantity:	10,100 m3

Disposal Site Johnstone Strait-Hickey Point
Number 119
Latitude 50°27.80'N
Longitude 126°04.80'W
Depth (m) 270

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3170	VAN IS-KELSEY BAY-MB	28-Jan-97	3,600 m3
	3170	VAN IS-EVE RIVER	03-Feb-97	2,400 m3
			Total Dredge Quantity:	6,000 m3

Disposal Site	Johnstone Strait-Hanson Island
Number	120
Latitude	50°33.50'N
Longitude	126°48.00'W
Depth (m)	350

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3170	VAN IS-PORT MCNEILL-MB	08-Feb-97	600 m3
	3170	VAN IS-BEAVER COVE-CANFOR	09-Feb-97	3,000 m3
	3170	VAN IS-PORT MCNEILL-WESTERN	09-Feb-97	1,200 m3
	3189	VAN IS-BEAVER COVE-CANFOR	05-Dec-97	1,800 m3
	3189	VAN IS-BEAVER COVE-MOWATT	06-Dec-97	600 m3
	3189	VAN IS-PORT MCNEILL-WESTERN	07-Dec-97	1,800 m3
	3189	VAN IS-PORT MCNEILL-MB	08-Dec-97	1,200 m3
	3189	VAN IS-EVE RIVER	09-Dec-97	1,800 m3
	3189	VAN IS-KELSEY BAY-MB	12-Dec-97	3,600 m3
			Total Dredge Quantity:	15,600 m3

Disposal Site	PWC 5
Number	154
Latitude	49°09.40'N
Longitude	122°59.70'W
Depth (m)	10

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Dredge	3171	FR-MAINTENANCE	17-Sep-97	12,000 m3
			Total Dredge Quantity:	12,000 m3

Disposal Site	Snake Island
Number	161
Latitude	49°13.30'N
Longitude	123°53.10'W
Depth (m)	32

Permit Type	Permit	Loadsite	Dump Start Date	Quantity
Vessel	3173	FR-NEW WESTMINSTER QUAY	14-Jun-97	2,400 tonnes
			Total Vessel Quantity:	2,400 tonnes

APPENDIX III

Images Obtained by ROPOS II

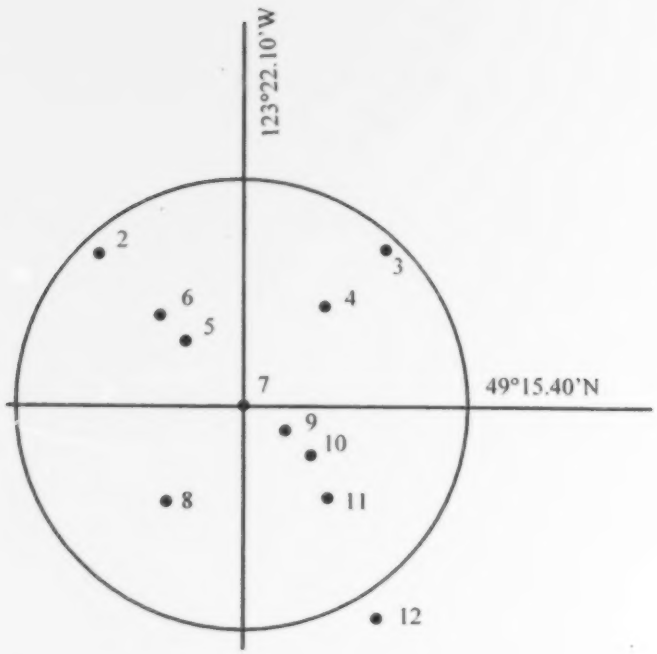

Figure 1. Point Grey disposal site boundary and locations of ROPOS images.

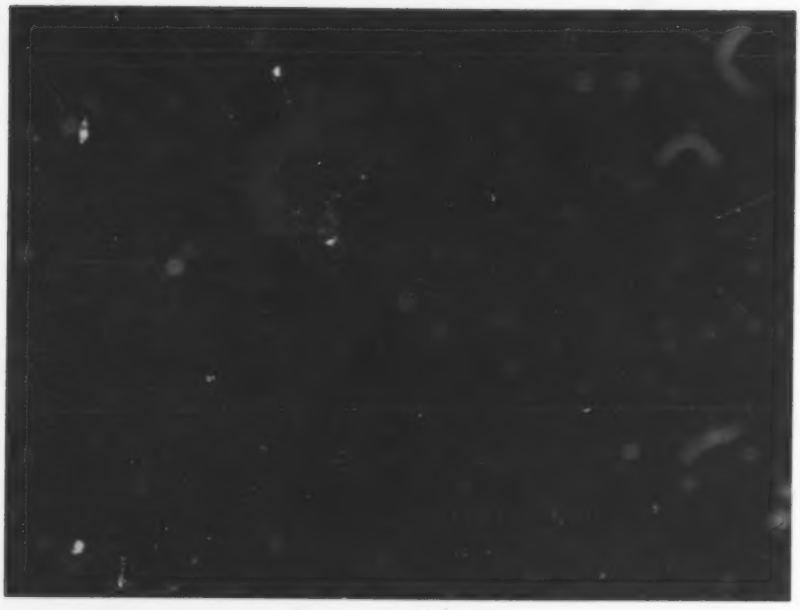

Figure 2. Sea cucumbers (*Parastichopus sp.*) are common on the disposal site.

Figure 3. Recent excavation spoils disposal.

Figure 4. Excavation spoils with covering of fine material from natural sedimentation in the Strait of Georgia.

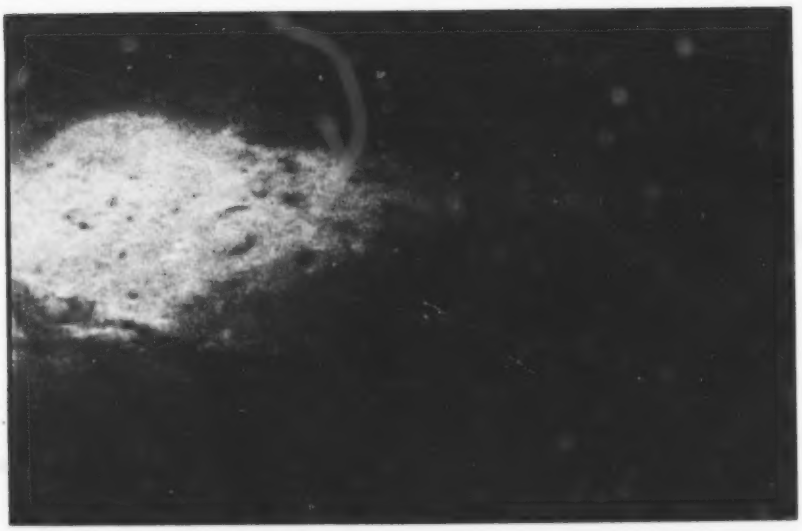

Figure 5. Concrete slab on mud bottom.

Figure 6. Woodwaste near the centre of the disposal site. Squat lobsters (*Munida quadrispina*) are common in areas where woodwaste provides cover and food.

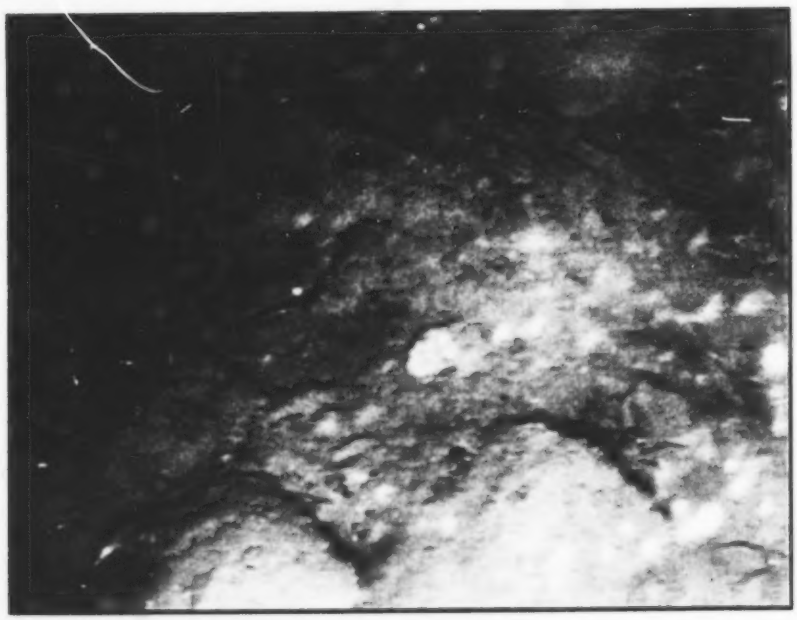

Figure 7. Excavation spoils and numerous squat lobsters (*M. quadrispina*).

Figure 8. Ratfish (*Hydrolagus colliei*) are common on the disposal site.

Figure 9. Typical woodwaste spoils at the disposal site.

Figure 10. Prawns (*Pandalus platyceros*) and squat lobster (*M. quadrispina*) in recently deposited woodwaste.

Figure 11. Woodwaste, bundle wire and excavation spoils.

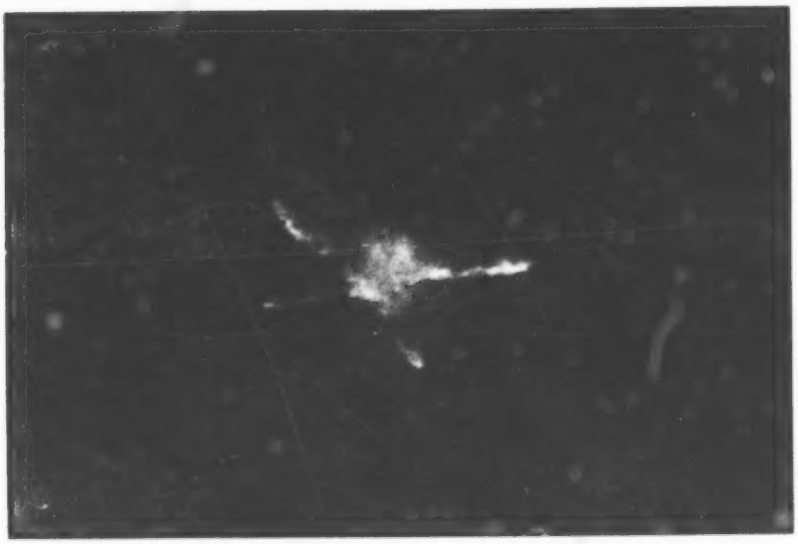

Figure 12. Mudstar on typical sediment type outside the disposal site boundary.